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# A PRELIMINARY CLASSIFICATION OF TREE VIGOR FOR WESTERN LARCH AND DOUGLAS-FIR TREES IN WESTERN MONTANA

By

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Tree vigor ranks high as an important factor in the silvicultural management of timber stands. The numerous classification systems in use today for different tree species demonstrate its wide acceptance. It is, therefore, not surprising that large differences in the growth rates of individual reserve trees in the larch-fir type are found to be associated with vigor. Data collected in 1947 as part of a study of cut-over larch-fir stands in western Montana provide a basis for a practical tree vigor classification for western larch and Douglas-fir trees.

Six hundred and eighty-five trees examined on 124 one-fifth-acre plots were classified into three broad vigor groups on the basis of certain crown and bark characteristics (see Table 1). Growth of each classified tree was compared with mean curved growth by d.b.h. classes and five-year periods since logging.

The study shows that deviations of growth from the average correlated strongly with vigor. (See Fig. 1). Trees in the best vigor group (Class A) grew nearly one and one-half times as much volume as the average, while the medium or fair vigor group (Class B) grew slightly less than the average, and the poorest group (Class C) grew only about one-half of the average volume. Consequently, the importance of leaving the best-vigor trees after logging is obvious.

## Factors Affecting Vigor

Characteristics used in Table 1 are based upon the following factors which affect growth:

1. Position of the tree in the stand
2. Size and condition of the crown
3. Age
4. Disease

Table 1.—Characteristics for classifying the vigor of western larch and Douglas-fir residual trees in larch-fir type in western Montana

| Characters | VIGOR CLASS | | |
|---|---|---|---|
| | A (Good vigor) | B (Fair vigor) | C (Poor vigor) |
| 1. Position of crown | Usually dominant or codominant, occasionally intermediate. | Ordinarily codominant and intermediate, rarely dominant. | Usually intermediate or suppressed, occasionally codominant and rarely dominant |
| 2. Length of the crown | Crown length 40 percent of the total height or longer. Unusually wide crown may be shorter but not less than 30 percent. | Crown length usually from 20 to 40 percent of total height. In narrow crowns greater length may be allowed. | Crown length usually will not exceed 20 percent of total height. In extremely narrow crowns greater length may be allowed, but not to exceed 50 percent. |
| 3. Width of the crown | Crown width average or wider. | Crown usually average width. May be narrow and long or wide and short. | Crown usually narrow or occasionally of average width. |
| 4. Shape of the crown | Tip usually pointed or round, never flat or spike topped. | Tip usually round, occasionally pointed, and rarely flat topped. | Tip usually flat or spike top, rarely rounded. |
| 5. Branching and foliage | Dead branches in the crown rare, branches and foliage moderately dense or better. Branches in upper half of crown usually strongly upturned and no drooping branches. | Occasional dead twigs present, usually no dead branches in the crown. Branches and foliage of moderate density. Occasionally large crowns of extremely open density. Usually the upper branches either upturned or horizontal, with drooping branches in the lower half of crown. | Dead twigs and branches showing through the crown. Often branches drooping to the tip. In western larch 1/ branches short and stout throughout the length of the crown. |
| 6. Bark | Western larch - Bark is usually dark in color and ridged or only slightly scaly with deep fissures between scales. Bark appears rough. These bark characters apply to western larch only. Do not use on Douglas-fir. | Western larch - Bark is usually dark around base of tree, becoming scaly above. Plates not well defined, but bark appears relatively smooth. These bark characters apply to western larch only. Do not use on Douglas-fir. | Western larch 2/ - Bark usually light in color with well-defined large, smooth bark plates and very shallow fissures between plates. Bark appears very smooth. These bark characters apply to western larch only. Do not use on Douglas-fir. |
| | Douglas-fir<br>Bark usually has broad, corky ridges at the base, with light brown new bark prominently exposed in the fissures, becoming uniformly and finely ridged and dark above. The upper quarter or more of the bole usually has smooth or slightly checked light grey bark. | Douglas-fir<br>Bark has corky ridges at the base of the tree, becoming uniformly and finely ridged above. New light brown bark not as prominent as in A vigor and usually extending only part way up the butt log. Dark, rough bark extends at least three quarters or more up the full length of the bole. | Douglas-fir<br>Bark rarely has the light brown new bark exposed in the fissures. Dark bark usually extends to the tip. Frequently the entire bole has dark, finely ridged bark. |
| 7. Disease | No mistletoe infection. | Rarely trees with light mistletoe infection. | Trees with visible indications of moderate to heavy mistletoe infection should be placed in this vigor class. |

1/ Frequently in western larch, short, stout branches near the tip give it the appearance of being pointed. This should not be confused with a pointed growing tip which usually has numerous thin branches and is normally obtusely pointed.

2/ Trees with this type of bark are overmature and usually growing slowly. They should be dropped one class below that in which they would otherwise classify. Thus, if a tree qualifies for A vigor, but possesses the light, smooth bark with well-defined plates and shallow fissures, it should be dropped to the B vigor class.

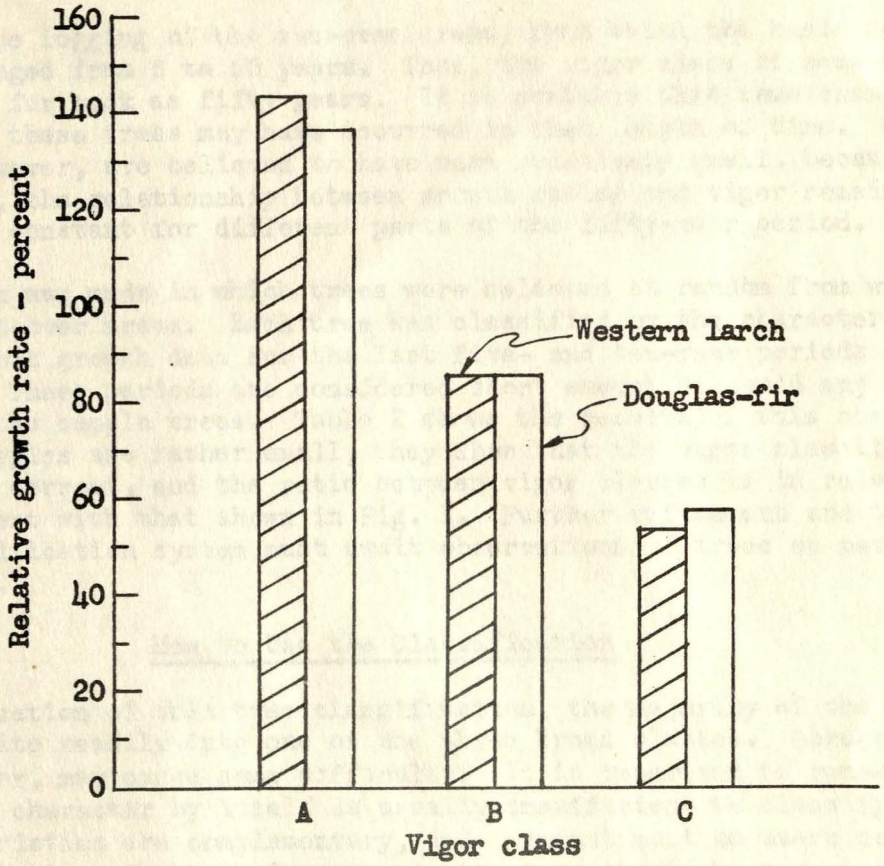


Fig. 1.—Relationship of tree vigor to board foot growth rates of western larch and Douglas-fir trees in cut-over stands, western Montana 1/ 2/

1/ Individual trees will deviate from these growth rates. They are applicable only to considerable numbers of trees. Relative growth rates in virgin stands will differ from these.

2/ Basis: 416 western larch trees and 269 Douglas-fir trees.

The role of the first three factors in tree vigor is self-evident. Under disease, however, dwarf mistletoe 1/ was the only one observed causing reduced vigor. Growth of heavily infected western larch trees may be reduced to as low as one-half the growth of normal uninfected trees. 2/ Therefore, heavy mistletoe infection will usually cause a tree to be placed in Class C vigor. It is not known what effect other diseases, such as needlecast and wood rots, have on vigor.

## Field Test

The time since logging of the cut-over areas, from which the basic data were obtained, ranged from 5 to 50 years. Thus, the vigor class of some trees was estimated as far back as fifty years. It is probable that some changes in the vigor of these trees may have occurred in that length of time. Changes in vigor, however, are believed to have been relatively small, because, in our analysis, the relationship between growth ratios and vigor remained surprisingly constant for different parts of the fifty-year period.

A field check was made in which trees were selected at random from widely scattered cut-over areas. Each tree was classified by the characteristics in Table 1, but growth data for the last five- and ten-year periods only were taken. These periods are considered short enough to avoid any changes in vigor of the sample trees. Table 2 shows the results of this check. While the samples are rather small, they show that the vigor classification is basically correct, and the ratio between vigor classes is in relatively close agreement with that shown in Fig. 1. Further refinement and testing of the classification system must await observations of trees on permanent sample plots.

## How to Use the Classification

In the application of this tree classification, the majority of the trees will fall quite readily into one of the three broad classes. Borderline trees, however, may cause some difficulty. It is important to remember that any one character by itself is usually insufficient to classify a tree. The characteristics are complementary, and judgment must be exercised in the interpretation of them. In general, the tree should be placed in the class for which the majority of the characteristics fit.

The strongest characteristics are: bark, density of the branches and foliage, shape of the top, form of the branches, and extent of mistletoe infection.

Application should be limited to trees in the larch-fir type, 10 inches d.b.h. and larger, 100 years of age and older, in western Montana. Its utility in other localities has not been determined.

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1/ Arceuthobium douglasii Engelmann on Douglas-fir and Arceuthobium campylopodum f. laricis (Piper) Gill on western larch.

2/ Weir, J. R., Larch Mistletoe: Some economic considerations of its injurious effects. 1916. U. S. Dept. of Agri. Bul. 317, Professional Paper. 25 pp., illus.

Table 2.--Comparison of board foot growth of trees classified by tree vigor with average growth

| Vigor Class | Average D.B.H. | No. Trees | Growth per tree Sample trees | | Deviation from average growth 3/ | |
|---|---|---|---|---|---|---|
| | | | Last 5 years | Last 10 years | 5 years | 10 years |
| | | Number | Bd. Ft. | Bd. Ft. | Bd. Ft. | Bd. Ft. |
| | | | Western larch 1/ | | | |
| A | 21.8 | 5 | 32.0 | 58.2 | + 8.4 | + 10.8 |
| B | 18.9 | 12 | 16.0 | 30.6 | - 3.4 | - 9.2 |
| C | 18.5 | 6 | 10.7 | 24.2 | - 9.0 | - 15.6 |
| | | | Douglas-fir 2/ | | | |
| A | 17.3 | 13 | 25.2 | 50.2 | + 10.2 | + 15.7 |
| B | 16.5 | 10 | 17.8 | 37.2 | + 0.9 | + 3.0 |
| C | 15.6 | 10 | 10.9 | 20.2 | - 4.2 | - 11.1 |

1/ Trees were measured on Coram Experimental Forest; Seeley Lake; and from Warland Creek, Five-mile Creek and Bristow Creek on the Kootenai Forest.

2/ Trees were measured on Coram Experimental Forest; Seeley Lake and Gold Creek on Lolo Forest; Lubrecht Experimental Forest; and Warland Creek on Kootenai Forest.

3/ "Average growth" as used here, means the mean growth for trees of this size as determined in the analysis of the original 685 trees.

It is believed that this preliminary vigor classification will prove useful to tree markers as an aid in the selection of fast-growing trees when partial cuttings are to be made in the larch-fir type. In addition, it has possibilities as a working tool in training inexperienced markers. The marker's ability to quickly "size up" a tree is enhanced by a knowledge and understanding of tree growth and vigor.

Table 1 has been made up in a reduced size, 3-3/4 inches by 6-3/4 inches, for insertion in pocket-size notebooks. Copies will be sent upon request.